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ABSTRACT

Pedagogical content knowledge is defined as the blending of subject matter knowledge, general knowledge of learning and teaching, knowledge about specific learners, and knowledge of instructional representations of subject matter such as activities, examples, demonstrations, analogies, and illustrations. This study was conducted to identify sources used by secondary school science and mathematics student teachers (N=14) in developing instructional representations of subject matter. All participants' preservice teacher education included classes in which teaching resource ideas were collected. Data were gathered through a questionnaire regarding sources of instructional representations. Data analysis suggests that: student teachers rely heavily on themselves for planning of instruction; curriculum material is seldom used as designed; teacher preparation course content or materials are not used; and the cooperating teacher and university personnel are considered important sources of materials and suggestions. Implications are that teacher education programs need to place more emphasis on how to effectively modify existing materials and create original products. (LL)

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SOURCES USED BY STUDENTS TEACHING IN LESSON PLANNING

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SOURCES USED BY STUDENT TEACHERS IN LESSON PLANNING

The concept of teachers' pedagogical content knowledge was introduced in the late 1980's by Shulman (1986) and his colleagues. Pedagogical content knowledge is the blending of a teacher's: (1) subject matter knowledge; (2) general knowledge of learning and teaching; (3) knowledge about the specific learners, including how they learn, their past experiences, and their current understanding of the subject matter; and, (4) knowledge of instructional representations of the subject matter.

Instructional representations of subject matter include all the activities, examples, demonstrations, analogies, illustrations, and so on that teachers may use for a given topic (McDiarmid, Ball & Anderson, 1989). A teacher's repertoire of instructional representations -- the teacher's bag-of-tricks -- comes, in large part, from experience.

A teacher's representations of subject matter may be derived from either internal or external sources. Internally derived representations are developed by the teachers themselves based on their understanding of the subject matter, their students' needs, and past experience with the material. External sources include curriculum materials, other teachers, workshops, and preservice training (McDiarmid, Ball & Anderson, 1989).

McDiarmid and others (1989) suggest that learning to evaluate instructional representations of subject matter is an important task for preservice teacher education. An implicit first step in this process is for prospective teachers to know

and use the various sources of activities, demonstrations, examples, and so on that are useful for the subject matter.

When selecting activities to teach, convenience is a big issue for teachers. Many teachers are textbook bound; they follow the text materials for content and activities. This is especially true for student teachers (Griffin, 1983).

Based on interviews with five mathematics student teachers, Bush (1986) found that textbooks played a major role in planning and teaching lessons. Ranked second and third as sources of decisions about planning, after mathematics textbooks, the student teachers relied on their methods course content and their cooperating teachers performance for teaching ideas.

In a study involving 76 experienced teachers (K - post-secondary) asked to create a teaching unit on a topic that they had never taught, the first concern was selecting the topic and how the topic would fit into the overall curriculum. Once the topic was chosen, the major concern was the availability and selection of resources and related materials to be used (Callaway, 1988).

The aforementioned research indicates that teachers are deeply concerned with how to represent subject matter, and most teachers rely heavily on textbook materials for these representations. If teacher education programs hope to prepare teachers with a strong pedagogical content knowledge base, there is a need to build a stronger resource base from which to develop instructional representations of subject matter.

The purpose of this research is to identify the sources used by secondary science and mathematics student teachers in developing their instructional representations of subject matter.

Methods

Description of Subjects

This study involved 14 of the 15 science and mathematics student teachers enrolled in a ten-week student teaching experience at a Pacific Northwest public state university. The group consisted of 8 males and 7 females. Ages ranged from 22 to 43 years, with a median age of 27 years. The student teachers were working toward certification in these areas: integrated science (5 students), biology (6 students), chemistry (2 students), and mathematics (2 students). Four of the subjects were graduate students, the remainder were undergraduates. Seven had student teaching assignments in large public high schools, 6 in public middle schools, and 2 in small multiple grade-level schools (one public rural, one private surburban).

Each of the subjects had completed their teacher education work at the same university. Included in their preparatory coursework were three classes in which they collected teaching resource ideas and had opportunities to teach and observe model lessons being taught (methods, practicum, and microteaching). In other pre-service undergraduate coursework they had observed practicing teachers in public school classrooms.

All subjects were enrolled in a student teaching seminar that met once a week during spring term. The format of the seminar allowed student teachers to share ideas and concerns.

Data Collection

The student teachers were asked to complete a questionnaire regarding their sources of instructional representations during the seminar. The questionnaire asked them to: (a) indicate where they acquired ideas for the subject matter content of the lessons they presented in the three consecutive teaching days prior to the questionnaire, (b) describe instructional representations that they used in their lessons for each day and indicate the sources that contributed to their development, and (c) state other sources which were regularly used in preparing lessons if their indicated sources were not typical (See Appendix for complete questionnaire). "Instructional representation" was described on the questionnaire and the subjects were free to ask questions while completing the instrument. An open-ended format was used rather than a checklist of sources so that students were not confined to pre-determined categories in their responses. The subjects were encouraged to give examples of how they represented their subject matter content, identify sources that contributed to the development of those representations, offer any explanations regarding the sources that were used, and comment on other sources that they typically used. The instrument was administered during the student teaching seminar in the fourth, sixth, and eighth weeks of the term.

Data Analysis

Ranking of Sources

Sources of instructional representations reported by the subjects were compiled from the questionnaire. Reported sources that appeared to be for subject matter content were not included although the information was requested on the questionnaire. Sources of subject matter content were requested so that the student teachers would delineate between instructional representations and overall curriculum content.

The sources were tallied and placed into categories. No predetermined source categories were used to organize the data. The frequency of the use of each source of instructional representation was determined and a ranking of sources was assembled. The percent of occurrence of the sources for each student was calculated and an average occurrence for the group was assigned to each category.

Results

Of the 15 students, 11 reported using adopted curriculum material, 10 said that they created instructional representations themselves or modified existing materials, 10 used their cooperating teachers material or suggestions, and 7 used other printed teaching resource material. Additional sources reported were college subject matter courses, the student teacher's own high school experience, conversations with or observations of other teacher, and suggestions from university supervisors and

other university personnel. None of the subjects reported using teacher preparation course content or materials.

The frequency of reported use of various sources for individual student teachers is presented in Table 1.

Discussion and Implications

The results of this study contradict those of Bush (1986). He has numerous reports of students teaching the way they were taught in their methods and other education classes. In the present study, none of the fifteen student teachers reported using materials or ideas from previous education courses. This is particularly meaningful since these courses emphasize collection of teaching materials and practice teaching methods.

After Adopted School District Curriculum Materials, the source most reported as contributing to how the content was presented to the pupils was the student teacher themselves. The reported sources ranged from original creation of materials to modification of ideas found elsewhere. It is unclear the role that teacher prepartation courses had in equiping the students to rely on themselves in planning. This question warrents further examinations.

These results need to be considered as preliminary, as they were unable to be followed by clarification interviews. Many student teachers may be unable to differentiate the source of the content from the source of instructional representations. Even

though the questionnaire included an explanation of "instructional representations" and a researcher was available to

TABLE I. Ratio of Planning Sources Reported by Student Teachers. (number of times reported / total sources mentioned)

Student Teacher I.D.	-1- CURRICULUM MATERIALS	-2- SELF	-3- CO-OP TEACHER	-4- RESOURCE MATERIALS	-5- CONTENT COURSES	-6- UNIVERSITY STAFF	-7- PERSONAL EXPERIENCE	-8- OTHER TEACHERS
1	0	0	3/3	0	0	0	0	0
2	11/14	2/14	1/14	0	0	0	0	0
3	6/16	0	5/16	5/16	0	0	0	0
4	1/10	4/10	0	5/10	0	0	0	0
5	0	0	2/4	0	1/4	1/4	0	0
6	8/12	0	2/12	0	2/12	0	0	0
7	4/11	3/11	0	4/11	0	0	0	0
8	8/17	3/17	3/17	2/17	0	0	1/17	0
9	3/21	3/21	5/21	4/21	3/21	3/21	0	0
10	9/9	0	0	0	0	0	0	0
11	0	8/13	3/13	2/13	0	0	0	0
12	0	5/10	5/10	0	0	0	0	0
13	6/15	2/15	0	0	4/15	0	2/15	1/15
14	5/20	11/20	3/20	1/20	0	0	0	0
15	8/21	9/21	0	0	1/21	0	0	3/21
AVERAGE %	33%	22%	22%	11%	6%	3%	1%	1%
NO. OF STUDENTS	11	10	10	7	5	2	2	2

EXPLANATION OF SOURCE CATEGORIES:

1. CURRICULUM MATERIALS -- Adopted textbooks, laboratory manuals, accompanying teacher guides, workbooks, and programmed curriculums.
2. SELF -- Original ideas and personal modifications
3. CO-OP TEACHER -- Any assistance from cooperating classroom teacher: suggestions, resource files, teaching observation, and direct instruction of methods.
4. RESOURCE MATERIALS -- Any printed material not adopted by school district or or from cooperating teacher.
5. CONTENT COURSES -- Methods or materials from college science or mathematics courses
6. UNIVERSITY STAFF -- Suggestions from university supervisor or faculty.
7. PERSONAL EXPERIENCE -- How they were taught in high school.
8. OTHER TEACHERS -- Observations or suggestions from classroom teachers.

answer questions during the assessment, some data were ambiguous. When sketchy information was provided, such as "text and myself", it was taken at face value. Examination of lesson plans in conjunction with interviews could indicated more clearly the sources of teaching ideas, and avoid the confusion with "how the topic was selected".

The questionnaires were administered during the weekly student teacher seminar. Several of the subjects were unenthusiastic about providing information even though they had voluntarily consented to participate. Some students were absent one or more weeks. A possible source of bias is the lack of information from those who were "too burned out to do this tonight" or for some reason could not make it to the seminar.

This study is subject to the implications concerning validity of any self report. The questionnaires were identified by the last four digits of the subjects' social security numbers; this does not provide complete anonymity. The student teachers were reporting to university staff that they may have wanted to impress, or felt that their answers may have affect on their evaluation for student teaching. Additionally, there are the limitations of recall and objective evaluation of their own teaching.

Despite the limitation of this study, the results are dramatic enough to offer some implications for teacher preparation programs:

(1) Student teachers rely heavily on themselves for planning of instructions. Despite all the curriculum material available, it is very seldom used as designed. Teacher preparation programs need to realize this and place more emphasis on how to effectively modify existing material or create original products.

(2) The cooperating teacher is an important source of materials and suggestions. It follows that the selection of those to serve as cooperating teachers should be done with care. The students teachers need someone who has the resources to share and whose suggestions are effective. Efforts should be made to foster a mentoring relationship between the cooperating teacher and the student teacher.

(3) Pre-service teachers often can not differentiate between instructional "topics" and "representations". Perhaps, clarifying this for the them will promote a conscious effort to select the most effective representations for a given topic.

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